A Revision of *Cristonia* (Fabaceae: Brongniartieae)

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Abstract

A revision of the Western Australian genus *Cristonia* J.H.Ross (Fabaceae: Brongniartieae) is presented. The number of taxa is increased from one to three. *Bossioea biloba* var. *stenophylla* Meisn. is resurrected and recombined at species rank to become *Cristonia stenophylla* (Meisn.) I.Thomps. and *Cristonia biloba* subsp. *pubescens* I.Thomps. is described as new. Distribution maps and identification keys are presented.

Keywords: taxonomy, *Templetonia*, legume, Western Australia.

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Introduction

Cristonia J.H.Ross. is one of six Australian genera in tribe Brongniartieae (Fabaceae), a tribe that also includes a few Central and South American genera. *Cristonia* was recently described (Ross 2001) to accommodate *Cristonia biloba* (Benth.) J.H.Ross, a species previously placed in *Templetonia* R.Br. and endemic to south-western Western Australia. *Cristonia* is distinguished from other genera in the tribe by a combination of features including apically bilobed leaves, axillary leaves, long-lobed calyces with a brown indumentum and basally cleft arils that have a narrow orifice.

Cristonia appears to be most closely related to *Lamprolobium* Benth. and *Thinicola* J.H.Ross based on both morphological and molecular data (Thompson *et al.* 2001). Their calyx morphology and the fimbriate lower margin of their keels are two features that distinguish them from other genera in the tribe.

Taxonomic history: Only two taxa have ever been described in what is now *Cristonia*. Both were initially placed in *Bossiaea* – *B. biloba* Benth. in 1837 and *B. biloba* var. *stenophylla* Meisn. in 1844. In 1976, Polhill transferred *B. biloba* to *Templetonia*, and in 2001 Ross transferred it to *Cristonia*. In neither instance was Meissner's variety considered worthy of formal recognition. However, in the current study, the pattern of morphological variation elucidated for *Cristonia* calls for its recognition as a species. Furthermore, it is considered that a third entity should be recognised at the rank of subspecies.

Methods

The pattern of morphological variation in *Cristonia* as reflected in the taxonomy presented below was identified through examination of herbarium material with the aid of a dissecting microscope. Assessment of floral morphology was aided by the reconstitution of dried flowers in hot water with added detergent. Specimens from CANB, MEL and PERTH were examined.

In *Cristonia*, taxonomically useful characters recognised in this study include: frequency of occurrence, size and number of axillary leaves;

shape, indumentum pattern and tubercle size of leaves; dimensions of the calyx and corolla; size of pods and seeds; and size and smoothness of the aril.

Taxonomy

Cristonia J.H.Ross, *Muelleria* 15: 9 (2001)

Type: *Cristonia biloba* (Benth.) J.H.Ross.

Erect subshrubs to c. 0.5 m high, taprooted, single-stemmed. *Indumentum* dense on younger branches, pedicels, bracts, bracteoles and calyces, variably dense on leaves, greyish to brown depending on organ, brownest on pedicels and calyces; hairs simple, fairly straight, brown basally, becoming white distally, generally antrorse-appressed. *Branches* moderately divergent to sub-erect, terete to slightly angular, with a whitish waxy coating evident when hairs lost; 1 or 2 axillary leaves smaller than subtending leaf often developed at lower- to mid-branch nodes, with a leaf-cluster sometimes additionally present. *Leaves* alternate, mostly sub-erect, simple, short-petiolate; lamina variable in shape, attenuate to cuneate basally, apiculate, sometimes enlarged and bilobed distally with lobes angled forwards; surfaces variably hairy, commonly glabrescent; estipulate. *Inflorescences* axillary, arising from a few to several successive nodes towards terminus of branches, with 1 or 2 flowers per axil; bract and bracteoles persistent, oblong-lanceolate, bract basal or near-basal; bracteoles inserted slightly below receptacle. *Calyx* persistent in fruit, brown to greyish externally, slightly fleecy internally; tube much shorter than lobes, upper lobes broader than lower, fused to form a ±oblong lip with apex more or less truncate, notched with sinus shallow; lateral lobes subequal to medial lobe; petals all of similar length, or wings a little shorter; standard yellow with purple-brown flare surrounding a greenish-yellow throat; wings predominantly purple-brown externally, yellow nearer margins; keel pale yellow-green, rarely tinged purple, margin minutely fimbriate; stamens all fused to form an adaxially open sheath; anthers alternately basifixed and dorsifixed, with basifixed anthers c. 1.5 times longer than dorsifixed anthers; ovary glabrous, 4–6-ovulate; stigma conspicuously capitate. *Pods* short-stipitate, moderately compressed, base broad-cuneate, surface undulating in correspondence with internal partitioning. *Seeds* ellipsoid, plump, body 4–5 mm long, brown, not mottled; hilum subapical; aril wall rather thick and deep, smooth or crenate, with a vertical lobe arising from one side, cleft at end nearest the lens, orifice c. 0.1 mm wide.

Distribution: *Cristonia* occurs in a band extending from Kalbarri in the north to the Perth region in the south, and mostly within 150 km of the west coast of southern Western Australia (west of longitude 116°30′ E).

Notes on morphology: LEAVES (Fig. 1). There is usually a slight change in size and shape of leaves between the base and termini of branches, with leaves generally shorter and more cuneiform nearer the base. There is also a moderate amount of variability within and between species in shape, including the distal lobation. A distinctive feature of *Cristonia* is the development of one or more often a pair of axillary leaves at some nodes (Fig. 1, a–d). Their placement, which is permanent, makes them resemble a pair of leafy stipules, and the overall arrangement of main leaf and axillary leaves is also reminiscent of the trifoliolate leaves in *Plagiocarpus* Benth., another Australian member of the Brongniartieae. A clustering of additional basal leaves also occurs in axils in *Cristonia biloba* (Fig. 1d). This clustering effect will be lost when the branch on which the leaves are inserted elongates. Some nodes have been observed where a pedicellate flower arises from one side of the leaf and an axillary leaf arises from the other side. This development of a pair of axillary leaves is also seen in *Hovea acanthoclada* (Turcz.) F.Muell., and in this species they are generally larger than the subtending leaf. The bract subtending a pedicel, although most resembling the bracteoles in size (Fig. 2a), are occasionally enlarged and greenish and reminiscent of these axillary leaves

The upper surfaces of leaves are initially hairy and each hair arises from a low tubercle. Hairs are generally soon lost, but close inspection often reveals a hair remnant persisting at the summit of these tubercles. The prominent tubercles at the leaf apex in *C. biloba* subsp. *biloba* distinguish it from the other two taxa.

FLOWERS (Figs 2a–d): Flower morphology is very similar in all taxa, although *C. stenophylla* generally has smaller flowers, and the extent of purple pigmentation of the wings is greater in *C. biloba* subsp. *biloba* (Figs 2c

Figure 1. Branches and leaves. a–c. Leaves along branch. a *Cristania stenaphylla* (single small axillary leaves evident near bottom *af* picture; *J.H. Rass 4093* MEL); b. *C. bilaba subsp. bilaba* (*H. Bawler 390* PERTH); c. *C. bilaba* subsp. *pubescens* (*E.A. Griffin 877* PERTH). d. *C. bilaba* subsp. *bilaba*, close-up *af* nade: main leaf angled to left, axillary leaf at 90° ta main leaf, leaves of axillary cluster directed vertically (*J.H. Rass 3832* MEL);. e–i. Leaf apices. e. *C. bilaba* subsp. *bilaba*, upper surface (*N.H. Speck*, 3.vii.1952 PERTH); f–i (lower surface): f. *C. biloba* subsp. *bilaba* (*G.J. Keighery 4990* PERTH); g. *C. stenaphylla* (*R.D. Royce 6456* PERTH). h. *C. bilaba* subsp. *biloba* (*H. Bawler 390* PERTH); i. *C. bilaba* subsp. *pubescens* (*A.J. Lin 44* PERTH). Scale bars: a–c = 5 mm; e = 2 mm; d, f–i = 1 mm.

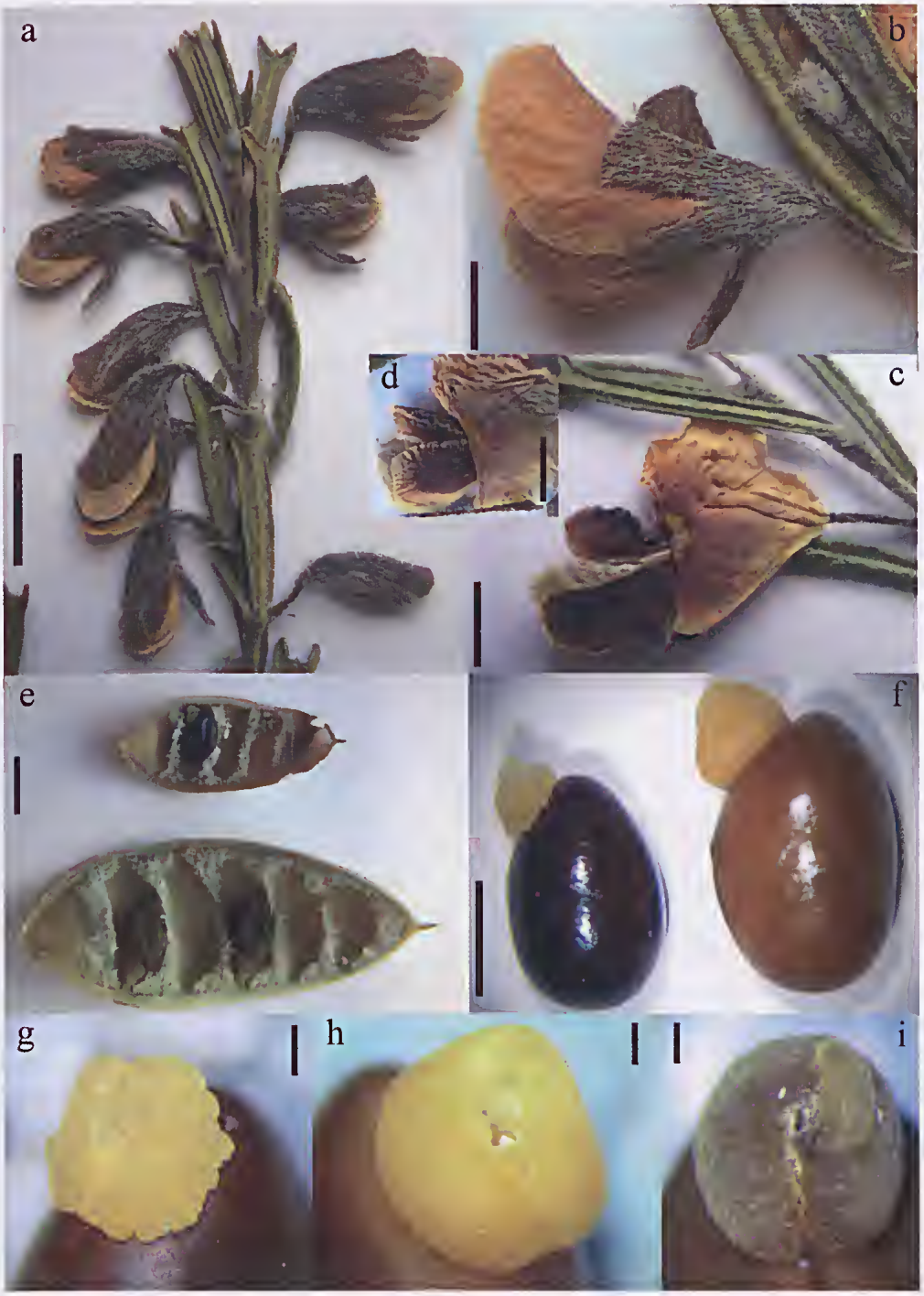

Figure 2. Flowers, fruits and seeds. a. Flowering branch (*R.J. Cranfield R28* PERTH). b–d. Flowers. b. *Cristonia stenophylla* (*N. Sammy* 15 Aug. 1985 PERTH); c. *C. biloba* subsp. *biloba* (*G. Smith 23* PERTH); d. *C. stenophylla* (*P. Armstrong S48* PERTH). e. Pod valves (inside view): top, *C. stenophylla* (*B. Smith 245* PERTH) & bottom, *C. biloba* subsp. *biloba* (*J.H. Ross 3832* MEL); f–i. Seeds. f. left, *C. stenophylla* (*coll. unknown*, MEL 664680) & right, *C. biloba* subsp. *biloba* (*J. Sewell*, 1888 MEL); g. *C. stenophylla*, aril (*coll. unknown*, MEL 664680), h. *C. biloba* subsp. *biloba*, aril (*J. Sewell*, 1888 MEL), i. *C. biloba* subsp. *pubescens*, aril (*E.A. Griffin 673* PERTH). Scale bars: a = 10 mm; b–e = 5 mm; f = 2 mm; g–i = 0.5 mm.

Key to species

Note: Select younger leaves when assessing indumentum.

1: Pods 6–9 mm wide; aril 1.3–1.5 mm in diameter, with wall crenate; lower- to mid-branch nodes sometimes with 1 or 2 axillary leaves to 5 mm long, but without additional leaves clustered; hairs evenly scattered over lower surface of leaves; upper-branch leaves generally not or hardly dilated apically ..... **1. *C. stenophylla***

1 Pods 9–14 mm wide; aril 1.8–2.5 mm in diameter, with wall entire; lower- to mid-branch nodes usually with 2 axillary leaves to 20 mm long and often also with additional leaves clustered; hairs not evenly scattered over lower surface of leaves (usually localised to midrib) or if so then leaves markedly dilating apically ..... **2. *C. biloba***

& 2d). The keel in *Cristonia* has a fimbriate lower margin, a feature also seen in *Thinicola* and *Lamprolobium*. Plants with yellow-petalled flowers have been noted by collectors.

PODS AND SEEDS (Figs 1a, 2e–i): The location of the cleft in the aril at the basal end distinguishes *Cristonia* from other genera in the tribe with the exception of *Plagiocarpus* in which some species display this feature to some extent.

1. *Cristonia stenophylla* (Meisn.) I.Thomps., *comb. et stat. nov.*

Bossiaea biloba var. *stenophylla* Meisn., *in* J.G.C. Lehmann, *Pl. Preiss.* 1: 85 (1844).

***Type*:** Western Australia. Swan River, *J. Drummond 264*; holo: W (right-hand specimen), photo seen MEL 2120315; iso: MEL 501184.

Erect subshrubs to c. 0.6 m high, with subtuberous taproot. *Stems* to c. 2 mm in diameter; 1 or 2 axillary leaves to c. 5 mm long sometimes developed; axillary leaf-clusters not developed. *Leaves* sometimes caducous below mid-branch; petiole c. 1 mm long; basal and lower-branch leaves with lamina cuneate to linear-cuneate, to c. 30 mm long, to c. 8 mm wide, sometimes dilated apically with sinus to 2 mm deep; mid- to upper-branch leaves with lamina narrow-linear, 3–5 mm wide, 20–70 mm long, 1–4 mm wide mid-leaf, not dilating at apex or dilating by up to 1 mm; base attenuate; margin strongly revolute; apex rounded or truncate or occasionally bilobed and/or emarginate, with sinus to 0.8(–1.5) mm deep, sometimes with a triangular medial lobe to 2 mm long arising from sinus; upper surface minutely tuberculate with minute hair remnants sometimes persistent at summit, or more or less smooth; lower surface with scattered loosely appressed hairs, variably glabrescent. *Pedicels* 5–12 mm long; bract 2–3.5 mm long, inserted basally or up to 3 mm distal to base; bracteoles 1.5–2.5 mm long, inserted 1–2 mm below calyx. *Calyx* 6–9 mm long, grey-brown; tube 40–45% of total length; upper lip 3.5–6 mm long, with sinus 1–2 mm deep; petals 10–16 mm long; standard-limb c. orbicular, c. 10–14 mm wide, with flare c. 2 mm wide, claw c. 3 mm long; wings often slightly shorter than keel, 4–5 mm wide, with pale margin up to c. 1 mm wide, claw c. 3 mm long; keel 4–5 mm deep, claw c. 3 mm long; ovary 4–6-ovulate, with style c. 10 mm long. *Pods* with stipe 1–2 mm long; body ±oblong or oblong-elliptic in profile, 15–25 mm long, 6–9 mm wide, 3–5-seeded; seeds 3.5–4.5 mm long, dark brown to blackish; aril 1.3–1.5 mm in diameter, c. 1 mm tall including lobe, crenate.

***Selected specimens of c. 40 examined*: WESTERN AUSTRALIA.** 32 km from Port Gregory along Yerina Springs Rd, *N. Sammy*, 15.viii.1985 (PERTH); N of Geraldton, *R.D. Royce 6456*, 29.vii.1961 (PERTH); The Brothers, Moresby Ranges, *J. Brooker 45*, 8.vii. 2000 (PERTH); Kalbarri National Park, 200 m N of turn-off to Z-bend and the loop, 11 km NE of Kalbarri on Kalbarri–Ajana Rd, *J.H. Ross 4093*, 17.ix. 2000 (MEL 2105438); 37 km W of Coorow, *R.J. Cranfield 267*, 21.vii.1978 (CANB, PERTH); 27 km E of Murchison River mouth, *M.E. Phillips*, 27.ix.1962 (CANB).

***Distribution and habitat*:** Occurs in south-western Western Australia from Bolgart north to Kalbarri with all but the Bolgart record being north of Coorow (Fig. 3a). The distribution of *C. stenophylla* does not overlap that of *C. biloba*. Grows in white or grey sands, or red-brown clayey sand in heathland and shrubland.

***Flowering period*:** Flowers June to July.

***Notes*:** *Cristonia stenophylla* appears less leafy than *C. biloba* due to the smaller axillary leaves and lack of axillary clusters, and flowers, fruits and seeds are

Key to subspecies of *Cristonia biloba*

1 Lower surface of leaves mostly glabrous either side of midrib; upper-branch leaves becoming parallel-sided approaching zone of dilation; upper surface of leaves prominently tuberculate at apex of lobes; wings purple-brown virtually to the apex ..... **2a.** subsp. ***biloba***

1: Lower surface of leaves with hairs evenly distributed throughout; upper-branch leaves cuneate to zone of dilation; upper surface of leaves inconspicuously tuberculate; wings mostly purple-brown but distal millimetre yellow ..... **2b.** subsp. ***pubescens***

smaller. Compared to *C. biloba* subsp. *biloba* the upper surface of the leaf is less prominently tuberculate distally. However, *C. biloba* subsp. *pubescens* is similar to *C. stenophylla* in this respect. A specimen from Murchison River (Phillips CANB) is atypical in having upper-branch leaves lobed distally. However, in these leaves the apical sinus is not particularly deep and the amount of dilation is small, and in other respects the specimen conforms well with *C. stenophylla*. In some specimens of *Cristonia stenophylla*, hairs have been noted arising from veins of the keel close to the lower margin.

2. *Cristonia biloba* (Benth.) J.H.Ross, *Muelleria* 15: 11 (2001)

Bossiaea biloba Benth., *in* S.L.Endlicher *et al.*, *Enum. Pl.* 36 (1837); *Templetonia biloba* (Benth.) Polhill, *Bot. Syst.* 1: 309 (1976).

***Type*:** Western Australia. Locality unknown [Given as King Georges Sound but unlikely to be from this locality], *Hügel*; holo: W *n.v.*, photo MEL 2092155.

Erect subshrubs to c. 0.6 m high, with roots not seen; with rootstock extending progressively each year. *Stems* to c. 3 mm in diameter; a pair of axillary leaves to c. 20 mm long usually developed at lower to mid-branch nodes; axillary leaf-clusters usually also developed. *Leaves* generally persistent; petiole c. 1 mm long; basal and lower-branch leaves with lamina cuneate to linear-cuneate, to 15 mm long, to c. 8 mm wide, with apex truncate or bilobed apically with sinus to 5 mm deep; mid- to upper-branch leaves with lamina narrow-oblong to linear or oblanceolate up to lobes, 10–30 mm long, 1–4 mm wide mid-leaf, often bilobed apically and up to 6 mm wider than midleaf, sometimes not bilobed; base narrow-cuneate; margin nearly flat, recurved or revolute; apical sinus to 5 mm deep, sometimes a triangular lobe to c. 2 mm long, arising from sinus; apiculum commonly triangular; upper surface tuberculate, with tubercles minute to conspicuous, lower surface with hairs restricted to midrib or widespread. *Pedicels* 4–12 mm long; bract 2–5 mm long, inserted basally or up to 3 mm distal to base, sometimes with apex recurved; bracteoles 1–2 mm long, inserted 1–2 mm below calyx. *Calyx* 8–12 mm long, brown, or occasionally grey-brown; tube c. 1/3 of total length; upper lip 5–8 mm long, with sinus 1–2.5 mm deep; petals 12–18 mm long; standard-limb c. orbicular, c. 12–18 mm wide, with flare c. 3 mm wide, claw 4–5 mm long; wings c. as long as keel, 4–7 mm wide, purple-brown more or less throughout, or becoming yellow distally and/or along lower margin, claw 2–3 mm long; keel 4–6 mm wide, claw 2.5–3.5 mm long; ovary 3–6-ovulate, with style c. 10 mm long. *Pods* ±oblong or oblong-elliptic in profile, 15–35 mm long, 9–14 mm wide, 3–5-seeded; seeds 4–5.5 mm long, mid-brown; aril 1.8–2.5 mm in diameter, 1.5–2 mm tall including lobe, smooth.

2a. *Cristonia biloba* subsp. *biloba*

Leaves of mid to upper branches oblong or oblong-cuneiform below the dilation; apex sinus varying from slightly broader than deep to much deeper than broad; lower surface with hairs restricted to midrib or occasionally partially laterally. *Pedicels* to 12 mm long. *Wings* 4–5 mm wide, with purple-brown pigmentation reaching more or less to apex; keel 4–5 mm wide. *Seeds* 4.5–5.5 mm long, with aril 2–2.5 mm in diameter, with lobe c. 1 mm high.

***Selected specimens of c. 100 examined*: WESTERN AUSTRALIA.** Adjacent ACTIV industries, High Wycombe, *M. Hislop 1059*, 6.vi.1998 (PERTH); Helena River, Mundaring, *C.A. Gardner 538*, 10.vii.1920 (PERTH); Ellis Brook Valley reserve, *H. Bowler 390*, 27.vi.1999 (PERTH); Piesse Brook, intersection of Mundaring Weir Rd and Aldersyde Rd, 12.4 km SW of Mundaring, *J.H. Ross 3832*, 24.xi.1996 (MEL 2043459); Darling Range escarpment, Susannah Brook, *M.G. Corrick 9934*, 31.vii.1986 (MEL 1555244); Greenmount, Perth, *J.A. Chappill s.n.*, 29.xi.1991 (MEL 2010155); Helena Valley, *J. Seabrook 29*,

3.vii.1977 (PERTH); Junction of Perth to Toodyay and Dalgetty Rds, *B.H. Smith 1723*, 16.vii.1994 (MEL 2023375); Midland Junction, Swan River, *A. Morrison 10425*, 6.vi.1900 (CANB)

***Distributian and habitat*:** Occurs in the far west of south-western Western Australia between 30° and 33°S from Hill River–Badgingarra area south to the Perth area (Fig. 3b). Grows in sand and sandy-loams in eucalypt woodland.

***Flawering periad*:** Flowers winter.

***Nates*:** Generally a more densely leafy species than *C. stenophylla*. Some specimens have leaves that are mostly not markedly bilobed, particularly the smaller more basal leaves of a branch. Although there is possibly a genetic component to this variation, it is more likely to be due to poorer quality soils.

A specimen from Hill River (*N.H.Speck* 3 July 1952 PERTH), which is within the distribution of subsp. *pubescens*, is tentatively identified as subsp. *biloba* as its leaves have hairs restricted mainly to the midrib on the lower surface. Its leaves have an unusual sharply V-shaped sinus (Fig. 1e). The flowers are inadequate to ascertain the wing pigmentation.

The three specimens used for illustration by Ross (1982) have all been determined as subsp. *biloba*. The representation of leaves as cuneiform throughout in these illustrations is inaccurate.

2b. *Cristonia biloba* subsp. *pubescens* I.Thomps., *subsp. nov*.

A subspecie typica foliis cuneiformis infra lobi, pagina inferiore foliorum pubescenti, alis luteis apicem versus differt.

***Type*:** Western Australia. Western Titanium Leases, 7 km S of Eneabba, *E.A. Griffin 877*, 10.vii.1976; holo: PERTH.

Leaves of mid to upper branches cuneiform below the dilation, with width at base of dilation 25–50% wider than width mid-leaf, apex sinus generally markedly broader than deep; lower surface evenly covered with hairs. *Pedicels* to 7 mm long. *Wings* 5–7 mm wide, purple-brown becoming yellow in distal 1 mm; keel 4.5–6 mm wide, pale, often with a purple tinge distally and adjacent to upper margin. *Seeds* 4–4.5 mm long (but possibly not full size); aril lobe 0.4 mm high, with a shallow groove present at junction of lobe and wall laterally.

***Specimens examined*: WESTERN AUSTRALIA.** Western Titanium leases 8 km S of Eneabba, *E.A. Griffin 673*, 20.x.1976 (PERTH); Lesueur National Park, N/S Peron seismic line, junction first E-W track to S of Peron, *B. Evans 633*, 20.vi.1993 (PERTH); 200 m W from The View Drive, Mullering Rd, Dandaragan, *A.J. Lin 44*, 4.vii.2003 (PERTH).

***Distribution and habitat*:** Occurs in near-coastal western Western Australia between Eneabba and Dandaragan (Fig. 3c). There is some overlap with the distribution of subsp. *biloba*. Grows on brown sandy loam over laterite and grey and white sands over clay, in shrubland and heathland.

***Flawering periad*:** Flowers winter.

***Etymalagy*:** The epithet refers to the hairiness of the lower surface of the leaves (L. *pubescens*, hairy).

Notes: Although based on only four collections,

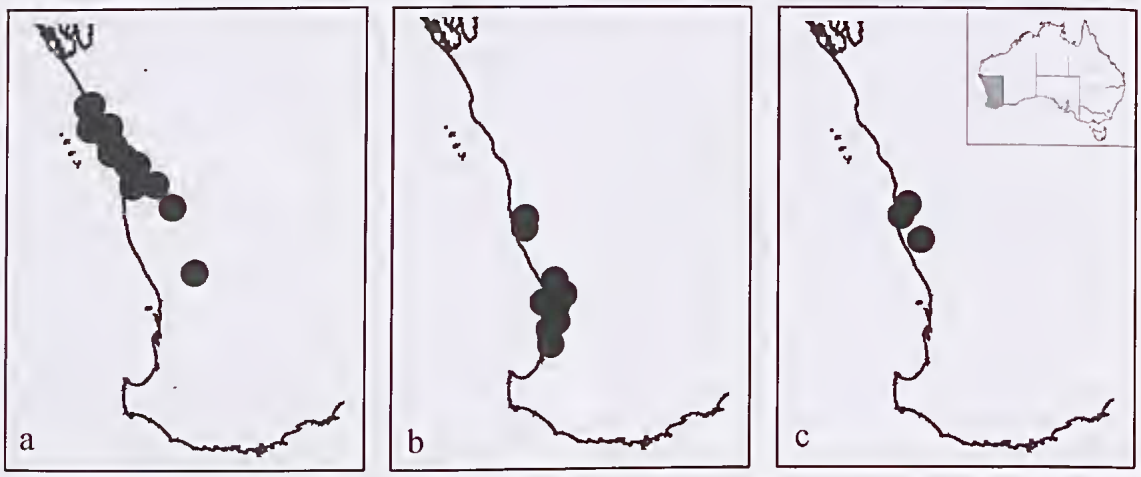

Figure 3. Distributions. a. *Cristonia stenophylla* b. *C. biloba* subsp. *biloba* c. *C. biloba* subsp. *pubescens*

there are sufficient differences, particularly in leaf shape and indumentum and seed characters, to warrant recognition at subspecies level. Further collections are desirable. Only one fruiting specimen exists, from Eneabba (*E.A. Griffin* 673 PERTH), and in this the pod partitions have a different texture to that of the type subspecies, and the arils of the seeds have a smaller lobe. A difference in colour may be due to slight immaturity (Fig. 2).

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